

Claims

- [c1] 1. A method for removing low molecular weight hydrocarbons from an exhaust gas of an internal combustion engine, the method comprising:
- a) contacting the exhaust gas with a water-removing composition; and
 - b) contacting the exhaust gas at a position downstream from the water-removing composition with a hydrocarbon-removing material to remove at least some of the hydrocarbons from the exhaust gas;
- wherein the hydrocarbon-removing material has a sufficiently low Si to Al atom ratio that less than about 50% of the low molecular weight hydrocarbons desorb from the hydrocarbon-removing material at a temperature of about 250 ° C.
- [c2] 2. The method of claim 1 wherein the hydrocarbon-removing material has a sufficiently low Si to Al atom ratio that less than about 50% of the low molecular hydrocarbons desorb from the hydrocarbon-removing composition at a temperature of about 275 ° C.
- [c3] 3. The method of claim 1 wherein the hydrocarbon-removing material has a sufficiently low Si to Al atom ratio that less than about 50% of the low molecular hydrocarbons desorb from the hydrocarbon-removing composition at a temperature of about 300 ° C.
- [c4] 4. The method of claim 1 wherein the hydrocarbon-removing material is a zeolite.
- [c5] 5. The method of claim 1 wherein the hydrocarbon-removing material is a pentasil zeolite, a faujasite zeolite, mordenite, a beta zeolite, ferrierite, a mesopore zeolite, or mixtures thereof.
- [c6] 6. The method of claim 1 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 25.
- [c7] 7. The method of claim 1 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 15.
- [c8] 8. The method of claim 1 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 10.

- [c9] 9. The method of claim 1 wherein the water-removing composition removes water vapor but not medium-sized hydrocarbons from the exhaust gas.
- [c10] 10. The method of claim 1 wherein the water-removing composition comprises a hydrophilic material.
- [c11] 11. The method of claim 10 wherein the hydrophilic material has a pore size of about 2 to about 5 angstroms in diameter.
- [c12] 12. The method of claim 10 wherein the hydrophilic material has a pore size of about 4 angstroms in diameter.
- [c13] 13. The method of claim 10 wherein the hydrophilic material is selected from the group consisting of molecular sieves, aluminas, silicas, zeolites, and mixtures thereof.
- [c14] 14. A vehicle exhaust system, comprising: a water trap; and a hydrocarbon trap comprising a hydrocarbon-removing material having a sufficiently low Si to Al atom ratio less than about 50% of the low molecular weight hydrocarbons desorb from the hydrocarbon-removing composition at a temperature of about 250 ° C; wherein the hydrocarbon trap is located downstream of the water trap in the vehicle exhaust system.
- [c15] 15. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material has a sufficiently low Si to Al atom ratio that less than about 50% of the low molecular hydrocarbons desorb from the hydrocarbon-removing composition at a temperature of about 275 ° C.
- [c16] 16. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material has a sufficiently low Si to Al atom ratio that less than 50% of the low molecular hydrocarbons desorb from the hydrocarbon-removing composition at a temperature of 300 ° C.
- [c17] 17. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material is a zeolite.
- [c18] 18. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing

material is a pentasil zeolite, a faujasite zeolite, mordenite, a beta zeolite, ferriete, a mesopore zeolite, or mixtures thereof.

[c19] 19. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 25.

[c20] 20. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 15.

[c21] 21. The vehicle exhaust system of claim 14 wherein the hydrocarbon-removing material is a zeolites having a Si to Al atom ratio less than about 10.

[c22] 22. The vehicle exhaust system of claim 14 wherein the water trap removes water vapor but not medium-sized hydrocarbons from the exhaust gas.

[c23] 23. The vehicle exhaust system of claim 14 wherein the water trap comprises a hydrophilic material.

[c24] 24. The vehicle exhaust system of claim 23 wherein the hydrophilic material has a pore size of about 2 to about 5 angstroms in diameter.

[c25] 25. The vehicle exhaust system of claim 23 wherein the hydrophilic material has a pore size of about 4 angstroms in diameter.